A COMPARATIVE STUDY OF HOUSING RECONSTRUCTION AFTER TWO MAJOR EARTHQUAKES: THE 1994 NORTHRIDGE EARTHQUAKE IN THE UNITED STATES AND THE 1999 CHI-CHI EARTHQUAKE IN TAIWAN

A Dissertation

by

JIE YING WU

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2003

Major Subject: Urban and Regional Science

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Approved as to style and content by:

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August 2003

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ABSTRACT

A Comparative Study of Housing Reconstruction After Two Major Earthquakes:

The 1994 Northridge Earthquake in the United States and

the 1999 Chi-Chi Earthquake in Taiwan. (August 2003)

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Though the idea of pre-impact recovery preparedness planning has recently been promoted by federal and state governments, very little research has been done to evaluate how it affects the process of disaster recovery. This research attempts to understand how pre-impact recovery planning affects housing reconstruction by examining the relationship of pre-impact recovery planning with housing reconstruction speed and the use of mitigation techniques during housing reconstruction. This study was conducted by comparing two cases, the City of Los Angeles, California and Taichung County in Taiwan.

This study finds that having a pre-impact preparedness recovery plan increases the speed of housing reconstruction. The relationship between having a pre-impact recovery preparedness plan and the extent to which hazard mitigation is integrated into the recovery process is not very clear, but the experience of the City of Los Angeles

suggests that having a pre-impact recovery plan allows local officials to make more effective use of the “window of opportunity” after disaster.

DEDICATION

To my Parents

ACKNOWLEDGMENTS

I gratefully acknowledge Dr. Michael Lindell, my committee chair, who always gave me excellent ideas and suggestions and provided a good learning environment for discussion and work. I also acknowledgment my advisory committee members: Dr. Dennis Wenger, Dr. Chengri Ding and Dr. Charles Graham, for their valuable criticism and advice. I also express my appreciation to Dr. Carla Prater, who always gave me immediate advice and insight for my daily research.

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CHAPTER I
INTRODUCTION

1.1 Problem Statement

Housing reconstruction after disaster is a major task in the disaster recovery phase. The immediate post-disaster period is obviously the time with immense potential for confusion, or at least the time for different stakeholders to take action that serves opposite or divergent purpose. The most obvious example is the conflict in recovery goals. Many local planning or redevelopment departments consider the rebuilding period to be an opportunity to implement urban renewal, but that takes time for coordination and negotiations. On the other hand, most of the victims hope to rebuild their housing as soon as possible. Major difficulties for the local government in the immediate post-disaster period include failure in recovery leadership (Rubin, 1985; Spangle Associates, 1997), ad hoc decision-making (Rubin, 1995), lack of preparation and poor coordination between departments (Rolfe and Britton, 1995). Also, existing recovery financing programs are not eligible for all classes of the victims (Comerio, 1998; Bolin & Standford, 1998).

Wilson (1991), Rolfe and Britton (1995), Geis (1996) and Milete (1999) suggested that pre-impact recovery planning is a powerful concept for more efficient and high quality decision-making as well as implementation. Pre-impact recovery

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This dissertation follows the style and format of the *Journal of American Planning Association.*

planning helps local governments not only to design recovery procedures that include leadership and coordination mechanisms, but also helps to examine their own resources and integrate outside resources.

Even though this idea of pre-impact recovery planning has recently been promoted by federal and state governments, very little research has been done to evaluate how it affects the process of disaster recovery. Does it actually accelerate the speed of housing reconstruction? Does it enhance hazard mitigation? Does it decrease the conflicts between short-term and long-term recovery goals? This dissertation has used two cases for a comparative study to understand how pre-impact recovery planning affects the housing reconstruction process.

1.2 Organization of This Dissertation

The following chapter presents the literature review for housing reconstruction after disaster. Chapter III presents the research hypotheses and research method of this study. Chapters IV and V present the housing reconstruction policies after the Northridge earthquake, and Chi-Chi earthquake. The final chapter of this dissertation presents a summary of the conclusions and offers suggestions for future research in this area.

CHAPTER II
LITERATURE REVIEW AND CONCEPTUALIZATION

2.1 Concept of Recovery

The term "recovery" is not very clear and sometimes it has been confused with some similar ones such as "reconstruction", " restoration", and "rehabilitation". Quarantelli (1999) concluded that "reconstruction" seemed to stress exclusively the post-impact rebuilding of physical structures destroyed or damaged in a disaster. "Restoration" appears to be a statement about reestablishing prior or pre-impact physical and social patterns. "Rehabilitation" seems to also suggest a restoration, although more of people than things. The term "recovery" has a broader scope, and it implies attempting to and/or bringing the post disaster situation to some level of acceptability. This might or might not be the same as the pre-impact level.

Haas, Kates and Bowden (1977) in their book *Reconstruction Following Disaster* proposed four stages of the post-impact period associated with recovery: 1) emergency response involving debris removal, provision of temporary housing, and search and rescue, 2) restoration of public services (electricity, water, and telephone), 3) replacement or reconstruction of capital stock to pre-disaster levels, and 4) initiation of improvement and developmental reconstruction involving economic growth and development of the locale. Rubin (1985) later challenged this linear dynamic model because her data indicated that this four-stage model might be too simplistic. In fact, she found that many of these periods overlapped and different portions of a community

could be in different stages of the recovery period at the same time. In the decade following her research, researchers gradually moved beyond seeing recovery as physical reconstruction. Nigg (1995) considered that recovery should not be conceptualized only as an outcome, but rather as a social process that begins before a disaster occurs and encompasses decision-making concerning emergency response, restoration and reconstruction activities following the disaster.

2.2 Pre-impact Planning for Post-disaster Recovery

Pre-impact planning for post-disaster recovery has been minimal in the United States (Mileti, 1999), but it has become more common in the past decade. Recovery training courses and handbooks are provided by the United Nations (UN)[1], the Organization of American States (OAS)[2], the Federal Emergency Management Agency's (FEMA) Emergency Management Institute[3], and state governments. Nonetheless, recovery planning is not a very common idea at the local level. Most communities, except some in California, Florida and North Carolina, are unprepared for the most basic challenges of disaster recovery such as restoration of infrastructure and

[1] UN Office for the Coordination of Humanitarian Affairs coordinated a series of training courses regarding rehabilitation and reconstruction. For more information, http://www.reliefweb.int/ocha_ol/index.html

[2] The Organization of American States (OAS) promoted recovery planning after Hurricane Georges stroke the eastern Caribbean. For more information, http://www.oas.org/pgdm/

[3] Emergency Management Institute, FEMA provides training courses such as course E-210: Recovery from Disaster, course E376 - State Public Assistance Operations etc. For more information http://www.fema.gov/emi

immediate housing needs (Petterson, 1999). So far, only Florida requires local plans for post-disaster recovery, and the mandate applies only in the coastal counties.

Research focused on recovery planning also is very limited. Rubin (1985) provided a framework for local recovery developed from 14 case studies, and concluded that personal leadership, ability to act and knowing what to do are three necessary elements to ensure an efficient community recovery. She implied that these three elements could be regarded as recovery planning and implementation. Wilson (1991) in his study on the Loma Prieta earthquake emphasized that recovery planning should be an ongoing, organization-wide process that has the full support and involvement of the top officials. Schwab, Topping, Eadie, Deyle and Smith (1998) considered that the purpose of planning for post-disaster recovery and reconstruction is to provide a vision for decision makers and a framework within which decisions will be made. The plan can provide decision makers with some general guidance and principles that they should follow to achieve long-term recovery goals.

Though it has not yet general widespread acceptance, the notion of pre-impact planning for post-disaster recovery is a powerful concept (Mileti, 1999). Planners like Mader, Spangle, and Blair offered suggestions regarding pre-impact actions that might ease the planning process that local governments would otherwise have to adopt and implement under great time pressure (Petterson, 1999). The political climate right after a disaster is obviously difficult for local public officials. Time is by far the most compelling factor influencing local government recovery decisions, actions and outcomes (Mileti, 1999). According to Wilson (1991), experienced local officials have

warned that if long-term recovery plans are not prepared in advance, there will not be time to consider how activities undertaken during the immediate response will affect long-term recovery. Similarly, Geis (1996) suggested that the more recovery issues can be thought through in advance, perhaps by means of disaster scenarios, the greater will be the efficiency and quality of post-impact decision-making.

The Recovery Annex in the Federal Response Plan (Federal Emergency Management Agency, 1999), emphasizes that coordination and planning are key elements in recovery. It states, " Before a disaster, interagency planning and coordination provide a foundation for strengthening relationships among Federal and State agencies, voluntary organizations, and private sector entities."(p. RF-3). Because of the rarity of pre-impact recovery planning, only one study has been done to evaluate the effectiveness of such plans following disaster. Spangle Associates (1997) conducted research after the Northridge earthquake in the City of Los Angeles by interviewing 39 local officials. The City of Los Angeles is unusual in that it had developed a long-term recovery and reconstruction plan before the earthquake. Spangle Associates found that, although few people actually referred to the plan after the earthquake, the process of preparing the plan was very helpful. Many local officials in Los Angeles mentioned that they knew what their responsibilities were and what needed to be done after the earthquake because they had resolved these issues during the planning process. Thus, the greatest benefit of this plan was not the written plan, but the planning process itself.

2.3 Housing Reconstruction

One major component of community recovery is housing reconstruction. Quarantelli (1982) proposed four types (phases) of shelter and housing that comprise the housing recovery path after disaster: emergency shelter, temporary shelter, temporary housing and permanent housing. Emergency shelter is usually established after a disaster at the instigation of individuals and households based on chance availability, convenience, proximity, and perceived safety (Bolin, 1993 a). Temporary shelters often are established in mass care facilities or large public buildings that are managed by American Red Cross in the United States, or governmental agencies or non-governmental charities organizations in other counties. In the United States, temporary housing aid is often provided by FEMA and primarily takes the form of cash grants for temporary housing rent until victims can reestablish permanent housing. In some instances, mobile homes are provided if existing rental stock in an area is not adequate to house disaster victims (Bolin, 1993 b). Pre-fabricated housing also has been used in Japan and Taiwan as temporary housing after severe earthquakes. The last stage of housing reconstruction is permanent housing, which can be rebuilt on the same site or another site after the disaster. FEMA provides individual assistance to victims by providing cash grants, and facilitating assistance from other federal agencies. This includes low-interest loans from Small Business Administration (SBA) and tax deductions from Internal Revenue Service (IRS).

Many factors contribute to a community's capacity to successfully reconstruct housing after a disaster--economic conditions, the nature of the federal and state role,

the disaster management system, and the regulatory system of land use and building practices--but the most important factor is finance for housing repair (Comerio, 1998). When we focus on financial issues, there are two major approaches to housing reconstruction. One is simply to let the market place sort out the winners and losers after a disaster, providing government and charitable aid only in the emergency period. The other is to let insurance or government programs provide very limited assistance for victims (Comerio, 1998). In fact, most housing reconstruction cases involve a combination of these approaches. Comerio's study of housing reconstruction after the Mexico City earthquake, the Northridge earthquake and the Kobe earthquake in Japan concluded that in developing counties, most of the funds come from international aid. In the developed countries, financing for recovery comes from domestic sources. These include national treasuries, taxes, and bonds in the public sector, and insurance and private borrowing in the private sector. Housing reconstruction cannot rely exclusively on market forces because of market failure, which is caused in part by a shortage of information for victims about where to get loans. This is especially true for ethnic minorities (Peacock et al., 1997). Therefore, recovery financing programs play a very important role in housing recovery.

In the United States, FEMA, the Department of Housing and Urban Development (HUD) and the SBA are the main agencies providing recovery programs. As noted earlier, FEMA offers "relief" types of assistance such as temporary housing programs, additional living expense programs and minimum home repair program. However, HUD is the focus for housing supply assistance programs such as the Community

Development Block Grant program and the Home Investment Partnerships program, which provide block grants for construction of new, and renovation of existing affordable housing, through local governments (Comerio, 1998). HUD also provides Section 8 vouchers for low income renters after a disaster. SBA has many disaster loan programs to offer low-interest loans for households to repair or replace damaged homes and for businesses to repair structures or replace lost inventory. These recovery programs include the Home-Owner Disaster Loan Program, Renter Disaster Loan Program, and Individual Disaster Loan Program. Non-government organizations (NGOs) also play an important role in the short-term recovery phase. The American Red Cross, the Salvation Army, and other religious and charitable groups provide mass care (emergency shelter and food), financial grants, and assistance with rebuilding and repair of housing to the victims.

In Taiwan, there was no existing disaster recovery program before the Chi-Chi earthquake except for natural disaster relief from the Ministry of Interior. After the Chi-Chi earthquake, the central government established many recovery programs, but these programs are only available for Chi-Chi earthquake victims. These programs include low-interest loans, discount public housing, health insurance deductible waivers, and unemployment grants. NGOs also play a very important role in the disaster response and recovery phase. The Tzu-Chi Foundation, which is a religious group, not only gave relief to the victims right after the earthquake, but also contributed more than half of the total pre-fabricated housing during the disaster recovery phase.

2.4 Integrating Mitigation Policies into Recovery

The recovery period is a unique time to enact mitigation policies. Hazard mitigation is advance action taken to reduce or eliminate the long-term risk to human life and property from hazards (Godschalk, Beatly, Berke, Brower and Kaiser, 1999). A range of mitigation measures can be incorporated to recovery, including improved building codes and construction standards, more effective land-use and community planning, and environmental management that reduces vulnerability (Berke & Beatley, 1997). These mitigation measures can be classified into three categories: community protection works, land use practices, and building construction practices (Lindell & Prater, in press). Community protection works include dams, levees, and drainage systems that protect an entire area from hazard impact. Land use practices include land use regulation (zoning), and comprehensive plans that limit the amount of property in vulnerable areas. Building construction practices include structural designs and construction materials that reduce the vulnerability of the structures that are located in the hazardous areas.

Many have recognized that the time period immediately after impact is a "window of opportunity" (Kingdon, 1995) to enact mitigation policies, because policy makers can use a disaster as a "focusing event" that can be exploited to induce desired policy changes (Birkland, 1997). But the opening of the policy window does not automatically result in policy change. The public needs to pay attention to the problem, and have new groups participate in public debate on the mitigation issue in order to produce policy change (Prater & Lindell, 2000). Nor will the "window" remain open indefinitely.

Kingdon has offered five reasons for the closure of a policy window. First, the window may close without action if no policy options are available for action at the appropriate time. Second, action on the problem may be taken and the problem resolved. Third, attempts may be thwarted, leading to a decrease in attention and finally a shift in political resources to the other issues. Fourth, agency personnel may change and new personnel may be unwilling to back any proposed change. Finally, the events that caused the crisis eventually will fade from public awareness, allowing attention to shift to fresh issues. To take advantage of the "window of opportunity" that opens after a disaster, policy entrepreneurs must ensure that the window closes because of the second reason (action taken and the problem resolved). Development of a pre-impact recovery plan appears to be the best way to ensure that this happens.

2.5 Developing Pre-impact Recovery Plans for Housing Reconstruction

After reviewing recovery planning in three cities, Schwab et al. (1998) proposed that four basic functions be addressed in a community recovery plan: Organization and authority, short-term rehabilitative functions, land use, and regional coordination. Within these four functions, the following elements should be planned before disaster:

1. Organization and authority: Select the members of the recovery task force, designate the lead agency, establish operations policy, set up an account system for disaster assistance, coordinate with the emergency manager, and institute public participation and hearings.

2. Short-term rehabilitative functions: Identify sites for temporary shelter and housing, identify sites for refuse disposal, establish a process for damage assessment, restore infrastructure, set policy for emergency building demolition, establish reconstruction priorities, set policies for reoccupancy permits, and set policy for emergency permitting.
3. Land use: Review case studies to identify new lessons from damage assessment, identify nonconforming uses, review sites for emergency operations, replan stricken areas, review evacuation shelters, reevaluate road capacity for emergency access and evacuation, identify vulnerable historical structures, and prepare area-specific building moratoria.
4. Regional coordination: Coordinate with federal and state agencies and neighborhood organizations, review contracts and mutual aid agreements with mass media, non-profit organizations and the private sector; and review emergency legislation.

The Organization of American States (2001) proposed a somewhat similar program of pre-impact recovery planning for the islands in the Caribbean and recommended the following four categories of activities:

1. Construction standards: Clarify the role of the Bureau of Standards, set up a committee with the public to agree upon standards for construction materials, and identify sources for these construction materials.
2. Household preparation: Conduct workshops for householders on disaster resistant design and safe building construction practices.

3. Construction sector preparation: Make available and promote the adopted national building code, and promote good design though hardware supplies and contractors.
4. Policy development: Formulate policy and regulations for leased land, maintain enforcement of zoning laws, and ensure all ministries and government organizations use the existing building standards.

Comerio (1998) considered that an ideal disaster-rebuilding policy must minimize the potential for damage through serious and effective mitigation programs and, when damage occurs, link property owners to reliable sources of recovery capital.

Combining the concepts above, a good pre-impact recovery plan establishes agreement about long-term recovery goals, lets the stakeholders know what are their roles, informs people where are the resources after the disaster, and makes use of the window of opportunity. A good pre-impact recovery plan also should have the following elements for housing reconstruction:

1. Establish a recovery task force and leading agency,
2. Identify the recovery financing programs for which different classes of residents are eligible, and
3. Integrate mitigation policy into the recovery process.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Definition of Terms

- Apartment: A structure contains two or more housing units. Only one owner owns the entire structure.
- Condominium: A structure contains two or more housing units. Each housing units has its owner.
- Housing reconstruction: In this study, housing reconstruction refers to the procedure where damaged structures had been torn down and rebuilt.
- Multifamily housing: A structure contains two or more housing units. Usually multifamily housing refers to apartments and condominiums.
- Single-family housing: A structure is a separate building that either has open spaces on all sides or is separated from other structures by dividing walls that extend from ground to roof. Usually only one owner for a single-family housing unit.
- Window of opportunity: A period of time right after a major disaster that can be used to adopt new policies.

3.2 Research Hypotheses

As shown by the literature review, time pressure is the key issue that makes pre-impact recovery planning so valuable. Theoretically, having a pre-impact recovery plan

will shorten the time needed for decision-making and enhance government agencies, knowledge of what resources they have, where the resources are located, and what they need to do after the disaster. But very little research has been done to see how pre-impact recovery planning actually affects on housing reconstruction activities. To examine how pre-impact recovery planning affects housing reconstruction activities, this study will examine the following two hypotheses:

H_1: Having a pre-impact recovery planning will increase the speed of housing reconstruction.

Pre-impact recovery planning will shorten decision-making time after disaster. Furthermore, pre-existing recovery financing programs will make it easier and quicker for victims to apply for reconstruction loans or grants.

H_2: Having a pre-impact recovery plan will increase the extent to which hazard mitigation is integrated into the recovery process.

If mitigation is formulated as a long-term recovery goal during pre-impact recovery planning, it should increase the opportunity for integrating mitigation into housing reconstruction. One of the Kingdon's (1995) explanations for closure of the window of opportunity is that policy change attempts may be thwarted, leading a decrease in attention and finally the political resource shift to the other issues. If mitigation has not been integrated into pre-impact recovery planning, it is likely to be overlooked due to time pressure after a disaster.

3.3 Study Design

Because many research studies on housing recovery after earthquake have been done in the United States, it is logical to choose a community in the United States as one of the study sites. The main reason to choose Taiwan as a comparison country is that the Hazard Reduction & Recovery Center had conducted some research related to emergency management in Taiwan. Moreover, both the United States and Taiwan are in areas that are highly vulnerable to earthquake, and both have experienced serious property loss from this hazard in the recent past. The 1994 Northridge earthquake had a magnitude of 6.7 on the Richter scale, killed 57 persons, and caused more than 7,000 injuries. It also caused about 20 billion USD in direct property losses. The 1999 Chi-Chi earthquake in Taiwan, also called the 921 earthquake, had a magnitude of 7.3 on the Richter scale, killed 2,417 people, and caused 11,305 injuries. The direct losses were estimated at 11.5 billion USD[4]. Both the Northridge earthquake and the Chi-Chi earthquake were the most destructive earthquakes in their respective countries in the past half-century (see Table 3-1). These two earthquakes provide a great opportunity to study how disaster recovery is implemented in these two counties. Therefore, this study will use City of Los Angeles in the US and Taichung County in Taiwan as case studies.

[4] All amounts reported below have been converted to US dollars at the 1999 currency exchange of 1 USD = 32 NT.

Table 3-1 Comparisons of Northridge Earthquake and Chi-Chi Earthquake

	Northridge Earthquake	Chi-Chi Earthquake
Date	January 17, 1994	September 21, 1999
Magnitude	6.8	7.3
People Killed	57	2,417
People Injured	>11,000	>7,000
Damaged Buildings	>51,000	>65,000

The City of Los Angeles, California had a population of about 3.8 million and 1,337,706 housing units (U.S. Census Bureau 2000). Over 65,000 housing units were completely destroyed or sustained substantial damage during the earthquake. As mentioned before, Los Angeles is an unusual city in that it had a long-term recovery and reconstruction plan done by the city government before the earthquake. Moreover, FEMA, HUD and SBA had existing recovery programs for victims.

Taichung County, Taiwan had a population of about 1.5 million that suffered 1,194 deaths and about 19,000 injuries during the earthquake. Of the 386,860 housing units at the time of earthquake, 18,608 collapsed and 18,771 were damaged. Before the Chi-Chi earthquake, Taichung County had no recovery plan. As noted earlier, the central government announced some relief and housing reconstruction loan programs immediately after the earthquake. Moreover, it also promulgated the “Working

Guideline for Post-Earthquake Reconstruction Planning", but this was not published until November 9, 1999, nearly two months after the earthquake.

The situation in these two jurisdictions before and after their earthquakes provides a good opportunity to examine the hypotheses of this study (See Table 3-2). The City of Los Angeles had a pre-impact recovery plan which included existing recovery programs at the federal and state government levels and programs integrating mitigation policy into the recovery process, By contrast, Taichung had no a pre-impact recovery planning and very few existing recovery programs. Therefore, the situations in both jurisdictions will help this study to examine the hypotheses. By comparing these two jurisdictions, this study will also examine the current concept of good pre-impact recovery planning on housing reconstruction. Of course, there are other differences between these two jurisdictions such as their political and government administration systems, and their economic situations that also could have affected the recovery process. Therefore, the nature of these differences will need to be considered in drawing any inferences about the role of pre-impact recovery planning. Moreover, it is likely that this comparative case study will identify many issue that need to be resolved in future research.

Table 3-2 Research Design

Issue	US-City of Los Angeles	Taiwan- Taichung County	Hypothesis
Housing reconstruction speed	• Had pre-impact recovery planning • Had pre-impact disaster recovery programs in Federal and State level	• Had no pre-impact recovery plan • Had very few pre-impact disaster recovery programs	H_1
Mitigation Policy	• Had pre-impact recovery and reconstruction plan • HUD's pre-impact program integrated mitigation policy into the recovery process	• Had no pre-impact recovery plan • Had only a few post-impact programs integrated mitigation into the recovery process	H_2

3.4 Research Method and Measures

This study relied heavily mainly on qualitative analysis of documents reviews and depth interviews. The study using the interview data from Spangle Associates, which conducted interviews with 37 government officers from City of Los Angeles in 1995. These officials came from 11 different departments and city council. The 11 departments are Department of Building and Safety, Department of Community Development, Industrial and Commercial Division, Community Redevelopment Agency, Housing Department, Planning Department, Police Department, Department of Public Works, (Chiquita Canyon Recycling Center, Earthquake Reconstruction Program), Department of Recreation and Parks, Department of Transportation, Office of the Chief Legislative Analyst, Office of the City Administrative and Mayor's Office. This study also conducted interviews with 22 Taiwanese government officers from

central and local level as well as 3 planners from consulting firms. The 22 interviewees including officers from 921 Earthquake Post-Disaster Recovery Commission, Council for Economic Planning and Development, Ministry of Interior from the central government and Department of Building Regulation, Fire Department, Planning Department in the Taichung County.

The independent variable for both Hypothesis 1 and 2 is that the presence or absence of a pre-impact recovery plan will be measured by the criteria (elements) developed on the literature review. Specifically, plans and programs were examined to determine the extent to each jurisdiction had: 1) established agreement about long-term recovery goals, 2) established a task force and leading agency after a disaster, 3) let stakeholders know what are their roles, 4) identified the recovery financing programs for which different classes of residents were eligible, 5) Informed people immediately where recovery resources could be obtained after the disaster, and 6) made use of the window of opportunity by integrating mitigation policies into the recovery process. The primary data source were be the housing recovery-related documents and plans in the two jurisdictions.

The dependent variable for Hypothesis 1 is the speed of housing reconstruction which was measured by the time that rebuilding permits were issued. The data were collected from official documents in the City of Los Angeles and Taichung County. Other data were gained through depth interviews with officers in the Department of Building and Regulation, Department of Public Works, and Offices of Emergency

Management, as well as articles in local newspapers such as the Los Angeles Times and Taipei Times.

The dependent variable for Hypothesis 2 is the extent to which hazard mitigation is integrated into the recovery process. This dependent variable was measured by the extent to which hazard mitigation was implemented into housing recovery related policies such as disaster recovery programs, land use planning, and comprehensive planning. The primary data sources were official documents from different levels of governments. Data also were collected through depth interviews with officers in the Planning Departments, Departments of Community Development, and Building Departments.

CHAPTER IV
HOUSING RECONSTRUCTION FOLLOWING THE 1994 NORTHRIDGE EARTHQUAKE

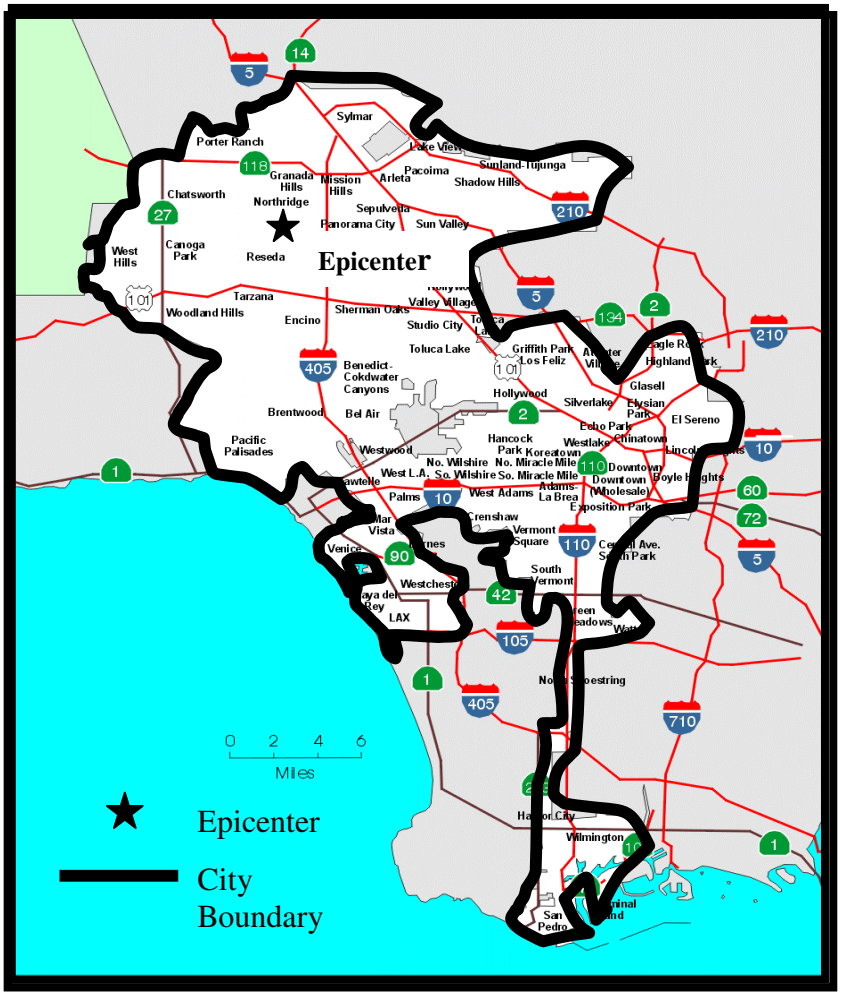
4.1 The Earthquake and City of Los Angeles

The Northridge earthquake struck the Los Angeles area at 4:31AM on January 17, 1994, with a magnitude of 6.7 on the Richter scale. The epicenter was in the San Fernando Valley (see Figure 4-1), a densely populated residential area northwest of downtown Los Angeles. Three counties were affected, Los Angeles, Ventura, and Orange, with 57 persons were killed and more than 7,000 injured. Perkins, Boatwright, Chuaqui and Harrald (1995) reported that 13,575 severely damaged buildings (red tagged) and 37,711 moderately damaged buildings (yellow tagged[5]). Direct loss was estimated at least $25 billion (OES, 1997). The Northridge earthquake prompted the largest federal disaster expenditure in the U.S. history, more than $12 billion in grants and loans (FEMA, 1996).

Los Angeles County, with nearly 9.5 million people, has the largest population of any county in the U.S. The City of Los Angeles alone has a population of about 3.7 million (Census Data, 2000). The economic structure is 19.1% industry and 60.9% service (City of Los Angeles, 2003). Average household income is about $38,000 (Census Data, 2000). After the earthquake, 75,741 buildings (409,901 units) were inspected in the City of Los Angeles about 77% of the units were multifamily dwellings

[5] Red tag means the building was rendered entirely uninhabitable. Yellow tag means the building needed further evaluation. Green tag means the building had experienced nonstructural damage and remained habitable.

and 23% were single-family dwellings[6] (OES, 1995). Ninety percent of the earthquake's damage was concentrated in the San Fernando Valley (OES, 1995).



Source: USGS and Los Angeles Almanac

Figure 4-1 The Epicenter of the Northridge Earthquake

[6] If classified by structure, not unit, the percentages of multifamily and single-family are about 25% and 75% respectively.

4.2 Conditions at the Time of Northridge Earthquake

The Northridge earthquake struck an area of the United States generally considered to be the best prepared to cope with a disaster, particularly a seismic event (EERI, 1995), because Los Angeles had experienced the Whittier Narrows earthquake in 1987 and was proactive in training each department to deal with a large disaster. In addition, the city had participated in response training after the Loma Prieta earthquake and took part in the Joint Symposium on Earthquake Hazard Management in the Urban Area (Comerio, Landis & Firpo, 1996).

As noted earlier, the City of Los Angeles was unusual in that it had a long-term recovery and reconstruction plan drafted before the Northridge earthquake called the Los Angeles Recovery and Reconstruction Plan (R&R Plan). This plan was a project of the Recovery and Reconstruction Division (R&R Division) of Los Angeles' Emergency Operations Organization (EOO), which launched an innovative planning process for post-earthquake recovery and reconstruction in 1987. This planning process involved representatives from academic fields as well as a number of city departments and took quite some time. At the time of the Northridge earthquake, the R&R plan was on the agenda of the Emergency Operations Board (EOB) for approval and was adopted five days after the earthquake.

The Northridge earthquake emerged as a focal point of political discourse and became an arena in which claims of disaster needs were publicly promoted at both the state and national level (Bolin & Standford, 1998). Since the Northridge earthquake occurred during the congressional election year, politicians at the federal and state level

immediately converged on the impact areas. The policies announced later had many political implications, especially for Democratic President Clinton and Republican Governor Wilson. President Clinton was the first Democratic president to carry California in a national election in 28 years. The response and recovery for this earthquake provided the impetus for his re-election in 1996 as well as for congressional candidates that year (Bolin & Standford, 1998). Clinton immediately declared the Northridge earthquake a national disaster on the afternoon of 17 January, resulting in a very rapid mobilization at the federal level. FEMA Director James Witt, Transportation Department Secretary Federico Pena, and HUD Secretary Henry Cisneros all arrived in Los Angeles by the evening of the first day. On 19 January, Secretary Pena committed to 100% federal coverage of repairs to interstate highways for six months without the usual requirement of 25% matching state funds. Secretary Cisneros also immediately disbursed $129 million in Community Development Block Grants to the region as well as 20,000 Section 8 housing certificates for low-income victims without preliminary loss estimates (Bolin & Standford, 1998). On 20 January, Governor Wilson requested that the federal committee provide 100% coverage for the Individual and Family Grant Program and the reconstruction costs for public buildings and highways without 25% matching state funds, but the federal government contributed only 90%.

4.3 Post-disaster Recovery Programs After the Earthquake

Some recovery financial programs from the federal government and a few from local government were available for housing reconstruction after the Northridge earthquake. Most of these assistance programs had been instituted before the earthquake. These programs were (also see Table 4-1):

1. Temporary Housing Program

   FEMA provided grants for housing rental assistance of $1,150 per month. Owners received this grant for three month, but it could be extended for 18 months. Renters could receive this grant for only two months. About 119,000 victims received this grant (FEMA, 1995).

2. Additional Living Expense Program

   FEMA offered mortgage and rental assistance for victims who were unemployed as a result of the earthquake to prevent foreclosure or eviction. FEMA paid the actual amount of the mortgage or rent for up to 18 months or until new employment was found, whichever came first. There were only about 1,000 applications for this program (FEMA, 1995).

3. Minimum Home Repair Program (MHRP)

   Homeowners whose dwellings sustained less than $10,000 in damage[7] were eligible for FEMA'S Minimum Home Repair Program. This program assisted victims to restore their homes to a livable condition. FEMA (1996) distributed

[7] The damage was determined by a FEMA inspector.

Table 4-1 Summary of Post-disaster Recovery Program after Northridge Earthquake

Program	Agency	Target Population	Funding or Time Limits
Temporary Housing Program	Federal Emergency Management Agency	Short-term rental. Assistance to displaced renters	3 months rental for owners and 2 months rental for renters
Additional Living Expense Program	Federal Emergency Management Agency	Rental and/or mortgage assistance to displace owners	18 months rent and mortgage assistance
Minimum Home Repair Program (MHRP)	Federal Emergency Management Agency	Homeowners with damage less than $10,000	Average $2,900
Individual and Family Grant (IFG)	Federal Emergency Management Agency, State Disaster Response service. 90/10 match	Homeowners and renters covering replacement of real & personal property	$12,200
Section 8 Rental Vouchers	U.S. Department of Housing and Urban Development	Low income renters	18 months (with possible extension)
Earthquake Emergency Loan Program (EELP) through Community Development Block Grant (CDBG) and HOME	LA Housing Department and U.S. Department of Housing and Urban Development	-	-
Assistance Loans for Homes & Personal Property	U.S. Small Business Administration	Homeowners or renters with damage	Loan Maximum $200,000 for real property and $40,000 for personnel property
Physical Disaster Business Loans	U.S. Small Business Administration	Damaged business	Loan Maximum 1.5 million depending on ability to repay the loan
Tax: Disaster Assistance Program	U.S. Department of Treasury	All victims	Income tax deductions for the losses
Rehousing Grants	City of Los Angeles	Victims with damaged hosuing	$500

Source: Comerio, et al.. Post-Disaster Residential Rebuilding, 1994.

about $841 million in MHRP grants to 288,000 homeowners with an average amount of $2,900.

4. Individual and Family Grant Program (IFG)

   Victims who were not eligible for other federal assistance programs could receive aid from the IFG Program for home repairs. Originally this was a FEMA-State joint program which required 25% matching funds from the state government. As mentioned earlier, FEMA eventually provided 90%. The maximum IFG payout was $12,200.

5. Section 8 Rental Vouchers Program

   HUD's Section 8 Rental Vouchers program offered rental assistance for households of qualified victims with income less than 50% of the US median. This rental assistance was good for 18 months, but could be extended. With Section 8 Vouchers, victims could rent any HUD- approved apartment. The federal government then paid the difference between 30% of the household's gross income and the rental amount.

6. Community Development Block Grants (CDBGs) and Affordable Housing Program (HOME) Grants

   HUD's CDBGs were given to city or county governments for develop reconstruction and development programs. HOME grants supported construction of multi-family residences and provided mortgage assistance for low income victims. The City of Los Angeles received $321 million in grants from HUD after the earthquake.

7. Assistance Loans for Homes and Personal Property

   The SBA offered low-interest loans to individuals for housing reconstruction. These loans covered non-insured losses on the home (real property) as well as personal property. The maximum loans for real property and personal property were $200,000 and $40,000, respectively. Both homeowners and renters could apply for personal property loans, but renters were not eligible for property loans. Home loans were typically issued to middle and higher income owners with good credit ratings. However; only about half of the 194,000 applicants received loans (Bolin & Standford, 1998).

8. Physical Disaster Loan

   HUD provided low-interest loans up to $1.5 million to business and rental property owners.

9. Tax Disaster Assistance Program

   The IRS allowed certain casualty losses to be deducted on Federal income tax returns for the year of the loss or through an immediate amendment to the previous year's return.

10. Rehousing Grants

    The City of Los Angeles Housing Department provided $500 rehousing grants for victims within five days after the earthquake.

4.4 Factors That Influenced Housing Reconstruction

As noted earlier, many factors contribute to a community's capacity to successfully reconstruct housing after a disaster--These include previous disaster experience, economic conditions, the roles of different levels of government, the disaster management system, and the regulatory system of land use and building practices, but finance is the most important factor (Comerio, 1998). Moreover, the factors mentioned above are interactive rather than independent of each other. For example, experience gained from the riots of 1992 raised key housing reconstruction problems and reinforced the disaster management system in the City of Los Angeles, the economic situation influenced victims' choice of rebuilding housing or moving to other places, and the roles of federal and state government influenced the allocation of reconstruction funding.

The financial resources for housing reconstruction can be classified into two categories: private sources such as personal savings, loans, and insurance and public sources such as SBA loans, FEMA grants, and HUD grants. According to data from the National Income and Product Accounts (NIPA), the savings rate in the US for the period from 1994 to 1997 was in the range of 2%-7%. A savings rate this low suggests that personal savings could not provide a major source for housing reconstruction. Indeed, data provided by the U.S. Office of Management and the Budget, the Governor's Office of Emergency Services, and the California Department of Insurance indicated that private insurers paid out almost 65.3% of the major housing

reconstruction funds after the Northridge earthquake. SBA loans contributed another 20.7%, and FEMA and HUD grants contributed 7% each. (See Figure 4-2)

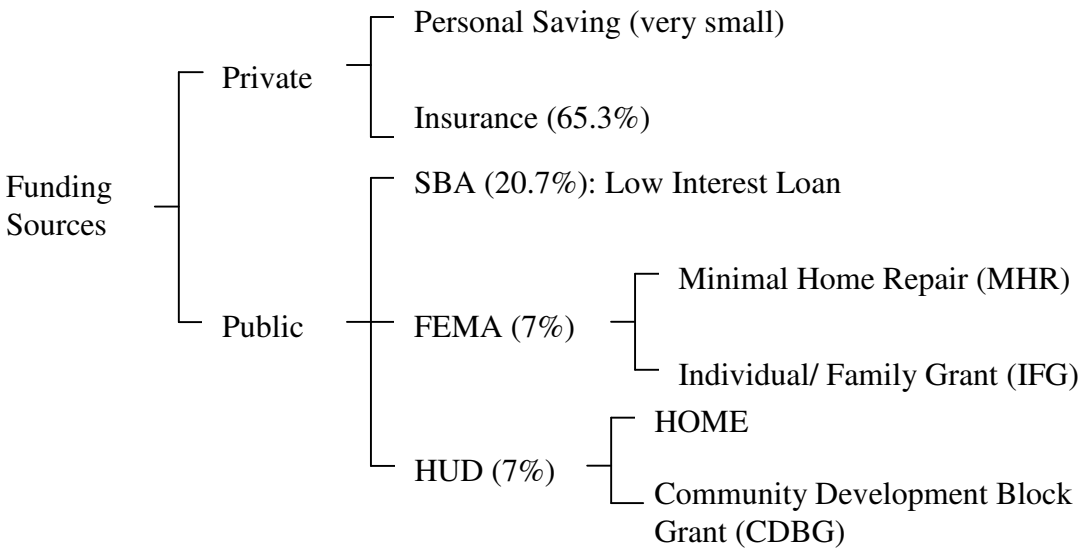


Figure 4-2 Funding Sources for Housing Reconstruction after the Northridge Earthquake

4.5 The Recovery and Reconstruction Plan and Housing Reconstruction

The overall concept of the R&R Plan was to develop planning and action before a disaster to significantly reduce recovery and reconstruction costs, hasten a return to normalcy, and create an improved city afterwards (City of Los Angeles, 1994). Four themes are central to this plan: planning; hazard mitigation; short-term recovery; long-term reconstruction. The R&R Plan contained policy statements with about 300 implementing actions organized into eight topical groups: residential, commercial and industrial rehabilitation; public sector service; economic recovery; land use/re-use; organization and authority; psychological rehabilitation; vital records; and inter-jurisdictional relationships. These implementing actions were divided into pre- and post-event actions. Lead responsibility for each action was assigned to one or more departments or agencies within the Los Angeles city government.

At the time of the earthquake, Los Angeles had a new mayor and a new planning director who were either unaware of, or not familiar with the R&R Plan. Since the leadership didn't emphasize this plan, many departments forgot that it existed during their operation after the Northridge earthquake. Spangle Associates conducted 20 interviews with 39 staff members from 11 different departments and the city council in 1995 and reported that less than half of the interviewees knew of the R&R plan at the time of earthquake.

Nonetheless, this does not mean that the R&R Plan had no effect on housing recovery. Many representatives from departments that participated in the R&R planning process had changed their departmental plans and, therefore, knew what their

responsibilities were and what they needed to do right after the earthquake even though they were unaware of the R&R Plan itself. Moreover, many departments had deployed recovery preparedness checklists that could accelerate the speed of housing reconstruction. For example, the Department of Building and Safety and the Department of Public Works had developed streamlined procedures for demolition before the earthquake. Before the earthquake, the Housing Department and the Community Development Department had set up similar policies to expedite building permits. According to the interviews data, this study found that these recovery preparedness policies did speed up housing reconstruction (See Table 4-2). These recovery preparedness policies were also integrated with pre-existing federal recovery programs such as SBA loans and FEMA and HUD grants. For example, the Housing Department staff knew the federal loan process and developed local loan guidelines and procedures that were compatible with federal requirements. Besides federal loans and grants, Los Angeles also had acted before the Northridge earthquake to establish a city loan program that provided a $500 rehousing grant.

Table 4-2 Actions That Each Department Took to Increase the Speed of Housing Reconstruction

Department	Actions Increasing the Speed of Housing Reconstruction
Building and Safety	• Establish criteria for emergency demolition contracts • Establish due process and procedures for demolition • Prepare pre-incident agreements • Set up a damage assessment system • Expedite building permits • Establish one-stop processing • Create parcel data base
Community Redevelopment	• Review and revise qualifying criteria for the city's neighborhood revitalization tools • Streamline procedures for redevelopment area expansions or additions
Housing	• Prepare emergency regulations • Identify staff in other departments who understand loan processing • Have procedures to adopt emergency regulations • Develop loan guidelines and procedures • Obtain pre-approval on loan procedure from federal agencies • Develop and implement city loan program • Identify available housing
Planning	• Update procedures to expedite permits • Insure consistency of R & R Plan with Safety Element • Prepare procedures, forms, list of R & R Division members • Determine criteria for balancing post-event work priorities
Emergency Operations Board	• Request formation of ad hoc committee on R & R, assist utilities in restoration, initiate demolition and debris removal program.
Chief Legislative Analyst	• Lobby for and support National Earthquake Insurance Program

Sources: Recovery and Reconstruction Plan, City of Los Angeles, California, 1994.

Interview data, Spangle Associates, 1995.

4.6 Housing Reconstruction Speed

Among the 19,229 approvals of housing rebuilding permits by the LA Building and Safety Department at the end of November 1996, 95.69% were single-family buildings, 1.63% were apartment buildings, and 1.16% were Condominiums. In terms of the damaged dwelling units, 77% were apartments and condominiums and 23% were single-family dwellings. Table 4-3 and Figure 4-3 show that the peak period of housing reconstruction was between March and August 1994, about three to seven months after the earthquake. The peak month was April 1994.

Figure 4-3 also shows that the speed of apartment and condominium reconstruction was slower than single-family buildings and didn't have a specific peak period. The City of Los Angeles faced a unique problem with areas of concentrated damage buildings scattered across the city after the earthquake. Thirty-eight census tracts out of 756 in the city had at least 100 vacated residential units, representing 12% of the housing stock, but two-thirds of the vacated housing in the city (Stallings, 1996). The LA Housing Department referred to the 17 most heavily damaged neighborhoods as "ghost towns". which were composed mostly of rental apartments and condominiums having owners who could not afford to rebuild or repair the abandoned structures. Many owners of large apartment buildings were in poor financial straits before the earthquake, so, the combination of high vacancies and declining property values caused by the Southern California recession meant that they had insufficient cash flow and insufficient equity to assume additional debt (Comerio, 1995). Most of the apartment owners could not receive SBA loans because of their inability to repay. The City of Los

Angeles identified this problem and petitioned HUD for special allocations from CDBG and HOME. Condominium reconstruction was different from apartment reconstruction, because many condominium owners had moderate incomes, were elderly, and had no earthquake insurance (Los Angeles Housing Department, 1995). The ownership pattern in which households owned individual units and the Home Owners' Association (HOAs) owned the building and the grounds complicated funding for repair or reconstruction, as FEMA aid applied only to the individual owner or renter, not the association (Bolin & Standford, 1998). This condition led the HOAs to increase the HOA fee to fund repairs or reconstruction[8]. Some owners could not afford to pay high fee and found it to their advantage to abandon their units. To prevent abandonment, the SBA developed a special program for HOAs and individual condominium owners, but required that HOAs would guarantee payment on the loan for unoccupied units. Thus, some still were not eligible for the loan under such a requirement. To solve this problem, the LA Housing Department, with HUD funding, developed another program for those who were denied by the SBA.

[8] In many cases, the HOA charged fee of at least $10,000 per household to pay the insure deductible (if applicable) or to pay for repairs.

Table 4-3 Rebuilding Permits Issued in City of Los Angeles

Issued Data	All Buildings		Single Family Buildings		Apartment Buildings		Condominium Buildings	
	Cases	%	Cases	%	Cases	%	Cases	%
Jan-94	3	0.02	1	0.01	2	0.64	0	0.00
Feb-94	579	3.01	564	3.07	12	3.83	1	0.45
Mar-94	1885	9.80	1853	10.07	11	3.51	8	3.57
Apr-94	2195	11.42	2160	11.74	18	5.75	13	5.80
May-94	2153	11.20	2094	11.38	21	6.71	25	11.16
Jun-94	1890	9.83	1868	10.15	13	4.15	7	3.13
Jul-94	1623	8.44	1608	8.74	11	3.51	5	2.23
Aug-94	1554	8.08	1529	8.31	15	4.79	5	2.23
Sep-94	1261	6.56	1229	6.68	17	5.43	10	4.46
Oct-94	907	4.72	884	4.80	14	4.47	4	1.79
Nov-94	741	3.85	716	3.89	9	2.88	10	4.46
Dec-94	665	3.46	643	3.49	10	3.19	9	4.02
Jan-95	318	1.65	305	1.66	9	2.88	3	1.34
Feb-95	319	1.66	203	1.10	9	2.88	5	2.23
Mar-95	393	2.04	366	1.99	16	5.11	12	5.36
Apr-95	301	1.57	283	1.54	9	2.88	6	2.68
May-95	485	2.52	457	2.48	9	2.88	18	8.04
Jun-95	360	1.87	242	1.32	9	2.88	4	1.79

Table 4-3 (Continued)

Issued Data	All Buildings		Single Family Buildings		Apartment Buildings		Condominium Buildings	
	Cases	%	Cases	%	Cases	%	Cases	%
Jul-95	227	1.18	185	1.01	13	4.15	22	9.82
Aug-95	205	1.07	178	0.97	9	2.88	17	7.59
Sep-95	135	0.70	124	0.67	5	1.60	5	2.23
Oct-95	140	0.73	115	0.62	13	4.15	10	4.46
Nov-95	120	0.62	96	0.52	14	4.47	9	4.02
Dec-95	71	0.37	65	0.35	4	1.28	1	0.45
Jan-96	85	0.44	75	0.41	7	2.24	2	0.89
Feb-96	66	0.34	57	0.31	4	1.28	4	1.79
Mar-96	84	0.44	77	0.42	4	1.28	2	0.89
Apr-96	79	0.41	75	0.41	4	1.28	1	0.45
May-96	84	0.44	79	0.43	5	1.60	0	0.00
Jun-96	96	0.50	86	0.47	6	1.92	2	0.89
Jul-96	55	0.29	51	0.28	2	0.64	1	0.45
Aug-96	50	0.26	46	0.25	3	0.96	0	0.00
Sep-96	27	0.14	23	0.12	3	0.96	0	0.00
Oct-96	38	0.20	35	0.19	2	0.64	0	0.00
Nov-96	35	0.18	29	0.16	1	0.32	3	1.34
Total	19229	100	18401	100	313	100	224	100

Source: Department of Housing and Safety, City of Los Angeles

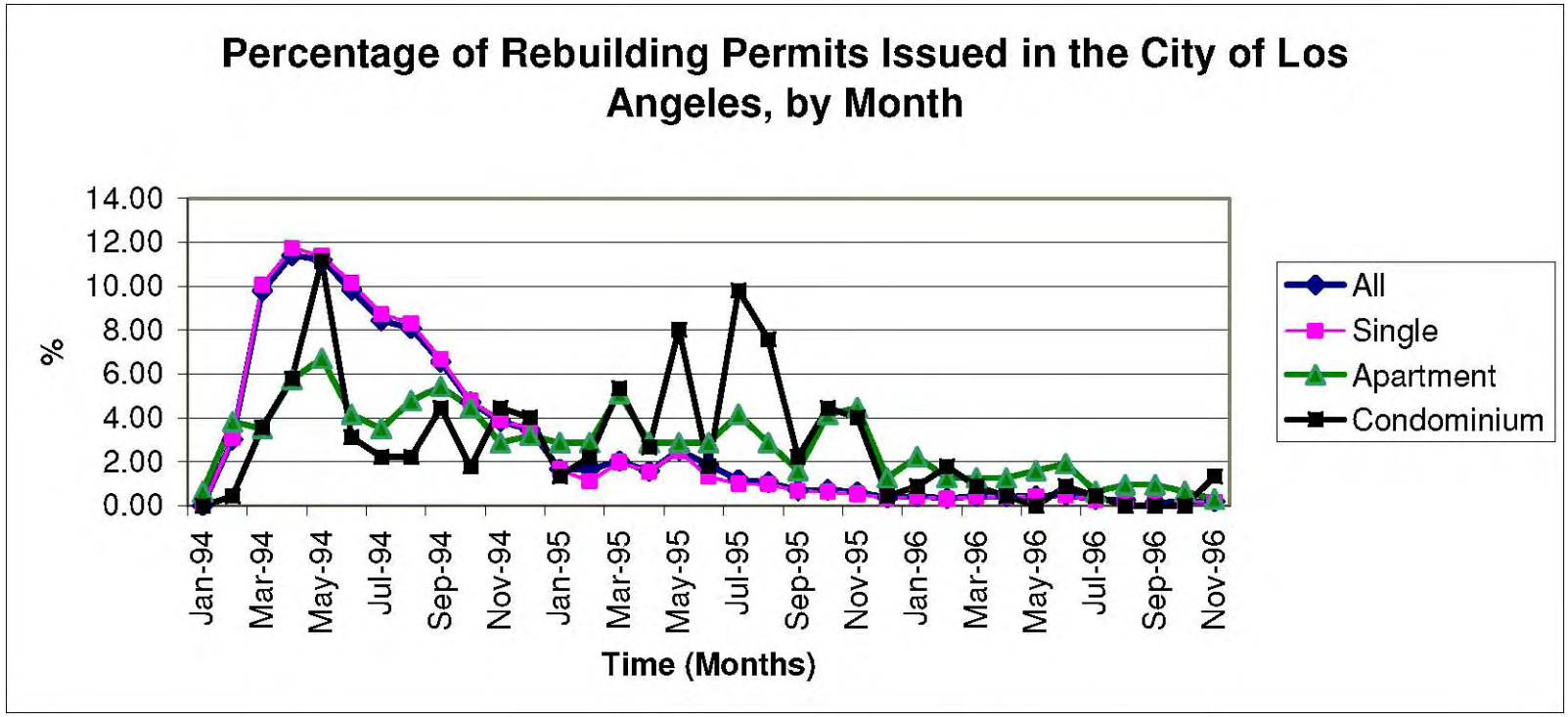


Figure 4-3 Percentage of Rebuilding Permits Issued in the City of Los Angeles

4.7 Mitigation Issues in Housing Reconstruction

The State of California is a leader in pre-disaster mitigation. Under a program authorized by Proposition 122, the Earthquake Safety and Public Buildings Rehabilitation Fund of 1990, the state legislature was able to offer $250 million for the financing of seismic retrofitting, reconstruction, repair, replacement, or relocation of state buildings or facilities and another $50 million in matching funds to help localities retrofit public buildings. The City of Los Angeles established the Mayor's Blue Ribbon panel on Seismic Hazard Reduction in 1993 to identify seismic risks and promote voluntary and mandatory retrofitting. The panel is comprised of five subcommittees: Buildings, Structures, and Lifelines; Seismic Risk; Land Use and Construction; Insurance, Banking, and Real Estate; and Educational Programs and Outreach.
Right after the Northridge earthquake, the city council passed an ordinance that required the retrofit of tilt-ups during the “window of opportunity.” This ordinance was drafted by the LA Department of Building and Safety and ready to submit before the earthquake. The department also established a task force right after the earthquake to learn the reasons for structural failures and recommend mitigation actions.

Some of the existing federal recovery finance programs also integrated mitigation policies. HUD’s Community Development Block Grant program, which provides aid to communities for a wide range of community development activities, can be used for disaster recovery projects with mitigation implications. HUD regulations promote the safety and soundness of all public and HUD-insured housing by requiring these structures meet the Minimum Property Standards (MPS) established by the Department.

The MPS has different standard for multifamily housings and one or two units of dwellings. These standards are more stringent than many local code standards. The FEMA Hazard Mitigation Grant Program provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. Individual homeowners and businesses may not apply directly to the program, but a community may apply on their behalf. After the Northridge earthquake, HMGP was mostly used for public buildings such as hospitals and classrooms. Very few grants were applied for on behalf of households and businesses. HUD‘s Office of Policy Development and Research (1995) conducted an earthquake mitigation report after the Northridge earthquake, which concluded that federal mitigation resources were mismatched with the needs. Almost 80% of the damaged residential units were multifamily housing and low-cost rental housing was particularly affected, but recovery programs were designed to serve middle-class owners of single-family housings. Moreover, it also found that most existing mitigation programs and resources were designed to address structural mitigation needs. The authors concluded that lack of attention to nonstructural mitigation methods might be the greatest threat to the safety of Los Angeles area residents.

CHAPTER V
HOUSING RECONSTRUCTION FOLLOWING THE 1999 CHI-CHI EARTHQUAKE

5.1 The Earthquake and Taichung County

The Chi-Chi earthquake occurred at 1:47AM on September 21, 1999, so it is also called the 921 earthquake. The magnitude of the Chi-Chi earthquake was 7.3 on the Richter scale and its epicenter was in the center of Taiwan, about 50 miles from Taichung County (see Figure 5-1). This was the most destructive earthquake in the past half-century in Taiwan, killing 2,417 people and causing 11,305 serious injuries in the entire nation. The earthquake also damaged more than 51,000 buildings nationwide (The 921 Earthquake Post-Disaster Recovery Commission, 2003). According to the 2000 data from the Directorate General of Budget, Accounting and Statistics, the overall financial loss caused by the Chi-Chi earthquake was about 11.5 billion USD.

Taichung County is located in the center of Taiwan with population about 1.5 million people (Taichung County, 2002). The economic structure of Taichung County is 48% industry and 44.1% service (Taichung County Fire Department, 1999). Because the earthquake's epicenter was not in the Taichung County[9], Taichung County didn't receive much support from the central government and private sector in the first two days after the earthquake. The earthquake killed 1,194 people and injured about 19,000 others in Taichung County; 18,608 buildings totally collapsed and another 18,771

[9]Due lack of communication, resources were initially sent to Nantou county, which was the site of the earthquake epicenter.

buildings were damaged (Taichung County Fire Department, 1999). The 21 Townships within Taichung County were all in the impact area. Eight Townships, Feng-Yuan, Tueng-Sh, Shin-Shou, Shih-Kang, Ho-Ping, Da-Li, Tai-Ping and Wu-Feng were the more seriously impacted areas (see Figure 5-2) that developed post-disaster recovery plans after the earthquake (Taichung County Fire Department, 1999).

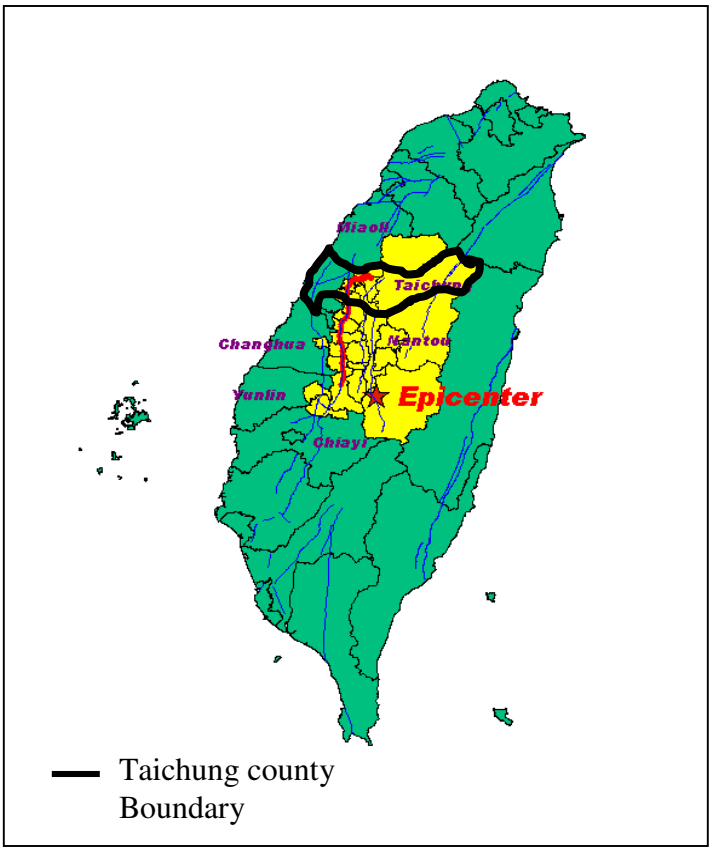


Figure 5-1 The Epicenter of Chi-Chi Earthquake

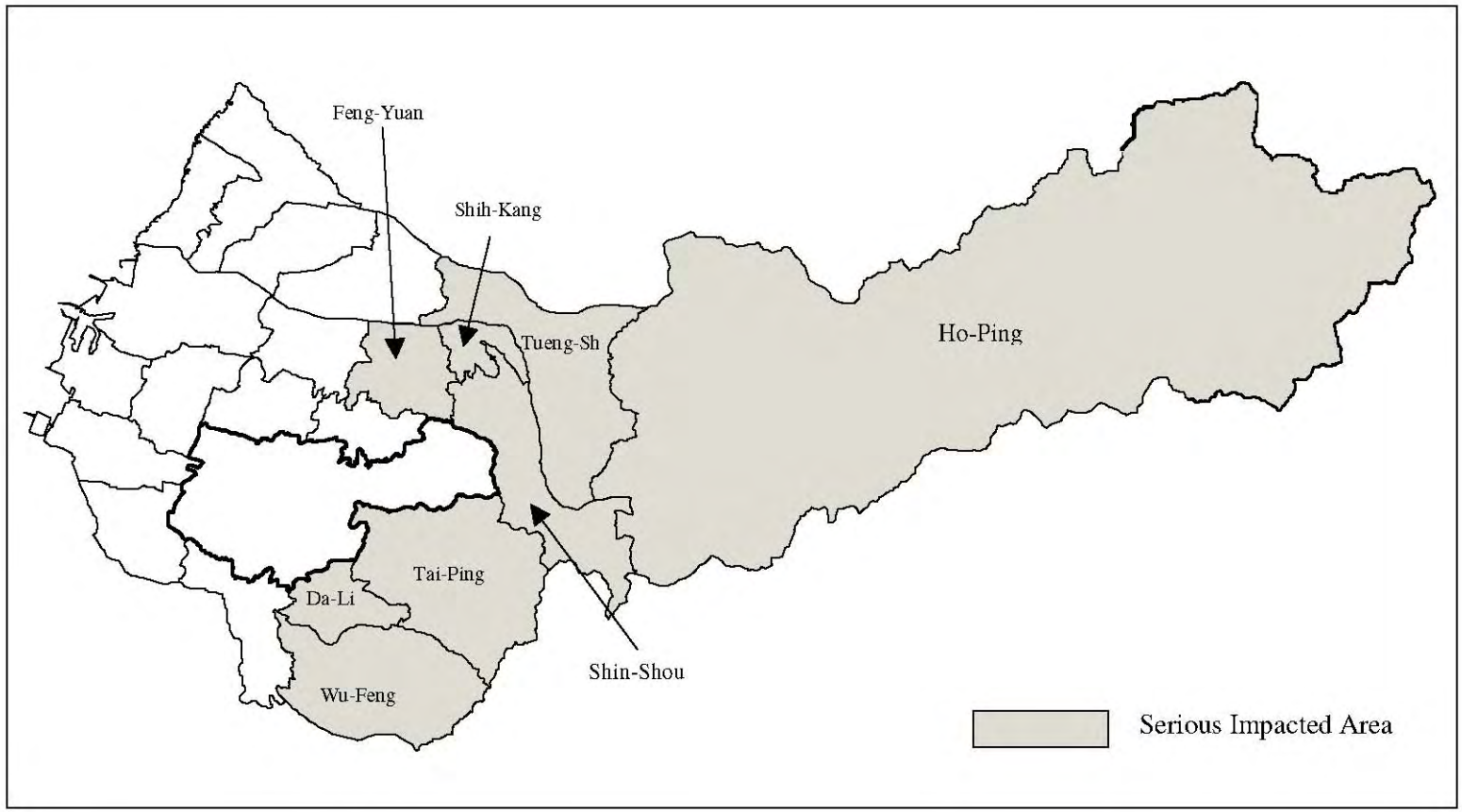


Figure 5-2 The Seriously Impacted Townships in Taichung County

5.2 Conditions at the Time of the Chi-Chi Earthquake

Taiwan is a highly centralized state in which the central government has a standard building code and standard urban planning procedures for the entire nation, but each jurisdiction may add regulations to fit its own needs. Because the entire island of Taiwan is vulnerable to earthquakes, the central government had developed a very strict building code, but construction practices are very critical. Some constructors skimped on work and stinted on material which made the buildings weaker than originally designed.

The disaster management system in Taiwan is very different from the US. The basic difference is that, in Taiwan, different agencies take care of different type of disasters. For example, the Ministry of Interior is responsible for the earthquakes and typhoons; the Ministry of Economic Affairs is responsible for floods; and the Council for Agriculture is responsible for debris flows. The Central Hazard Mitigation Council (CHMC) is the organization that coordinates disaster management policies at the central government level. The chair of CHMC is the deputy prime minister and council members are ministers from different agencies. Because the CHMC is not an organization in daily operation and its supporting staff mainly works for the National Fire Administration under the Ministry of Interior, the CHMC doesn't function very actively when there are no disasters. In spite of its name, the CHMC was more oriented toward the disaster preparedness and response function than toward the hazard mitigation function because of the backgrounds of its staff members. Local governments had similar structures but a more difficult situation than the central

government (see Figure 5-3). This management system was proposed three years before the Chi-Chi earthquake, but most of the agencies at all level of governments except the fire departments were not familiar with this system.

Since it had been more than 50 years since Taiwan had had a catastrophic earthquake, all levels of government lacked experience with post-earthquake housing reconstruction and none had a pre-disaster recovery preparedness plan. During the recovery phase, local governments relied greatly on the central government. Almost all the recovery-related policies and relief programs came from the central government. Because of the complicated recovery, the central government established a new specialized agency called the 921 Earthquake Post-disaster Recovery Commission, but this was not done until nine months after the earthquake[10].

[10] In the first nine months, similar task forces (not specialized agency) were also organized by the central government.

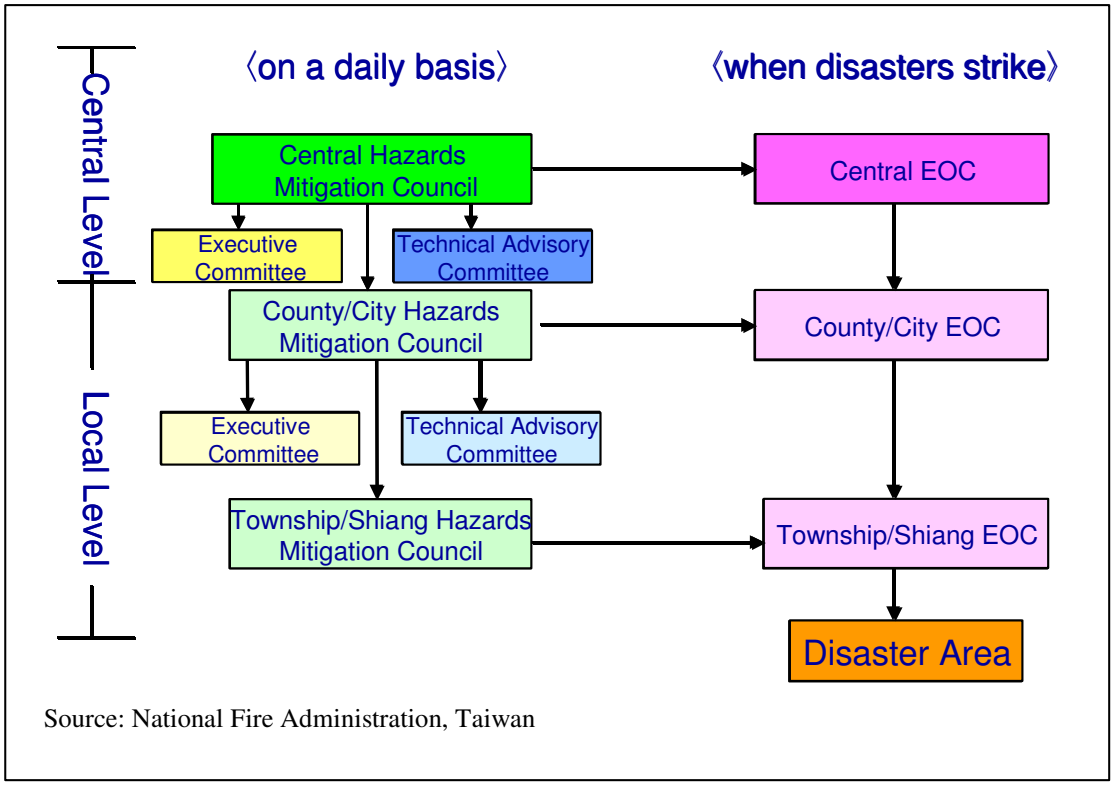


Figure 5-3 Emergency Management System in Taiwan

5.3 Post-disaster Recovery Programs After the Earthquake

Because Taiwan is a highly centralized state, most of the local governments except Taipei City need the central government's grants to construct infrastructure or promote welfare policies during normal times, not to mention during the post-disaster recovery period. In the recovery phase, the central government developed a series of programs to help victims by giving relief and grants or offering work opportunities, etc. These programs were intended only for the Chi-Chi earthquake victims and were announced a few days to two months after the earthquake. Some of these programs were criticized

for being too crude and not consistent due to the pressures of being so quickly organized. These programs were (also see Table 5-1):

1. Relief for Death and Injured

   After the 921 earthquake, the vice president raised the relief compensation to USD 31,250 (NT 1,000,000) for the dead and missing and USD 6,250 (NT 200,000) for the serious injured. Before the earthquake, the monetary relief for people who died or were serious injured caused by natural disaster was USD 6,250 (NT 200,000) and about USD 3,125 (NT 100,000) respectively. It is widely believed that the policy change was due to the presidential election scheduled for the next March because the Vice President at that time was a presidential candidate.

2. Housing Collapse Relief

   For completely collapsed buildings, each household[11] received USD 6,250 (NT 200,000). For the partially collapsed buildings, victims received USD 3,125 (NT 100,000). The neighborhood commissioners were responsible for investigating the housing's collapse status and obtaining approval from the township government. In case of controversy, professional engineers would accompany the neighborhood commissioners to double check. The policy of having neighborhood commissioners investigate the collapsed buildings was unwise, because few of the neighborhood commissioners had a professional background in building construction. As a result, more damaged buildings were declared as

[11] Only for those owners who lived in their houses when the earthquake struck.

Table 5-1 Summary of Post-disaster Recovery Program after Chi-Chi Earthquake

Program	Agency	Target Population	Funding or Time Limits
Death and Injured Relief	Ministry of Interior	Death or Injured victims	$31,000 for death relief and $6,200 for serious injured relief
Housing Collapse Relief	Ministry of Interior	Households with collapsed housing	$6,200 for totally collapsed building and $3,100 for partially collapsed building
Temporary Housing	Ministry of Interior	Households with collapsed housing and don't apply for housing rent relief	Move in the temporary housing for free
Housing Rent Relief	Ministry of Interior	Households with collapsed housing and don't apply for Housing rent relief	$90 per person per month up to 2 years
Public Housing Selling	Ministry of Interior	Households with collapsed housing	Buy public housing with 30% off
Employment Service	Council for Labor	Households with collapsed housing or family member was death caused by earthquake	Temporary working for government for 3 month. The wage is $500 per month. The employer can get $145 per month of subside up for 12 months if hiring a victim
Medicare Care Service	Department of Health	Victims received injured relief or housing collapse relief	Waive health insurance premium and deductible for 6 months
Tax Deduction and Exempt	Ministry of Finance	All victims	Income tax deductions for the losses caused by the earthquak. Waive land tax and housing tax for one year for the owners with collapsed buildings
Housing Reconstruction Loan	Central Bank	All victims with mortgage	No interest or low interest loan
Mandatory Military Service Waive	Ministry of Defense	Mandatory soldiers/ those going to mandatory service whose family member died caused by earthquake or his housing was totally collapsed	Discharge from military service/ waive 2 year mandatory service but need to serve as national guard for 3 months

totally collapsed than should have been because the neighborhood commissioners were running for election.

3. Temporary Housing (Prefabricated Housing)

   The government constructed about 15% of the prefabricated housing provided at no cost as temporary housing for victims. The private sector donated about 65% of the prefabricated housing. The Japanese government donated the remaining 20% of the temporary housing, which consisted of container houses that had been used after the Kobe earthquake. Victims from collapsed buildings could apply for temporary housing if they didn't qualify for housing rent relief.

4. Housing Rent Relief

   Victims who didn't stay in temporary housing could apply for housing rent relief at USD 93 (NT 3000) per person per month for up to two years.

5. Discounted Public Housing Sale

   The government provided a 30% discount to help victims buy public housing. Victims only needed to contribute USD 3,125 (NT100,000) of the down payment.

6. Employment Service

   Starting Oct 1st, 1999, the Council for Labor implemented a "Working Substitutes Relief" policy. Victims could apply for government work for three months. Usually this was manual, rather than professional, work that paid USD 468 (NT 15,000) per month. At first, many victims applied for this program, but many quit later because of the low salary. Also, the central government

implemented a program to encourage employers to hire victims. These employers received USD 156 (NT 5,000) per month from the government to subsidize employees' salaries for a maximum of 12 months.

7. Medicare Service

   Victims' health insurance deductible was waived for six months. Moreover, victims who received injury relief or relief for collapsed housing had health insurance premiums waived for six months.

8. Tax Deductions and Exemptions

   Victims could apply for income tax deductions for losses caused by the earthquake. Victims with collapsed or damaged housing also had land tax and housing tax waived for one year. Moreover, the heirs of death victims could avoid the inheritance tax if the inheritable deposit in a financial institution was less than USD 230,000.

9. Housing Reconstruction Loans

   Victims could apply for a no-interest/ low-interest loan from the Central Bank through a commercial financial institute for a maximum of USD 109,375 (NT 3,500,000) for 20 years. The interest would be waived if the amount of the loan was less than USD 46,875 (NT 1,500,000) and was assessed at 3% when the amount was over this amount. Victims could also postpone paying both the principal and interest for the loan on completely collapsed buildings for five years (five years for principal and six months for interest for the partially collapsed buildings).

10. Mandatory Military Service Waiver

    Those who were in the mandatory military service could apply for a discharge ahead of their scheduled release date if their parents, spouse, brothers, or sisters passed away due to the earthquake. Those who had a family death and were going into mandatory military service for two years could receive a waiver and transfer to the National Guard for only three months.

5.4 Factors That Influenced Housing Reconstruction

Financing was as important a factor influencing housing reconstruction after the Chi-Chi Earthquake as it was with the Northridge earthquake. Because only a very small percentage of the population had earthquake insurance[12], victims' major funding sources were personal savings and public relief/loans (see Figure 5-4). In Asian society, the saving rate is usually very high--as high as 26.2% at the time of earthquake (2000, Directorate General of Budget, Accounting and Statistics, Taiwan). Therefore, most victims used their savings to partially fund housing reconstruction. The survivors also could use their death and injury relief or the housing collapse relief for housing reconstruction. They could also apply for a low-interest housing reconstruction loan from the Central Bank through commercial banks, but many people complained that it was difficult to get these low-interest loans because of the mortgage requirement. The survivors might choose not to rebuild the collapsed building and move to another place. This is what usually happened to condominium victims because of difficulties in rebuilding. Considering accessibility to the workplace, the survivors could buy commercial housing or discount public housing in a nearby area. According to data from the Taiwan Ministry of Interior, only 545 households chose to purchase discounted public housing.

[12] According to the data from Ministry of Finances, Taiwan, less than 2% of the households had earthquake insurance in 1999.

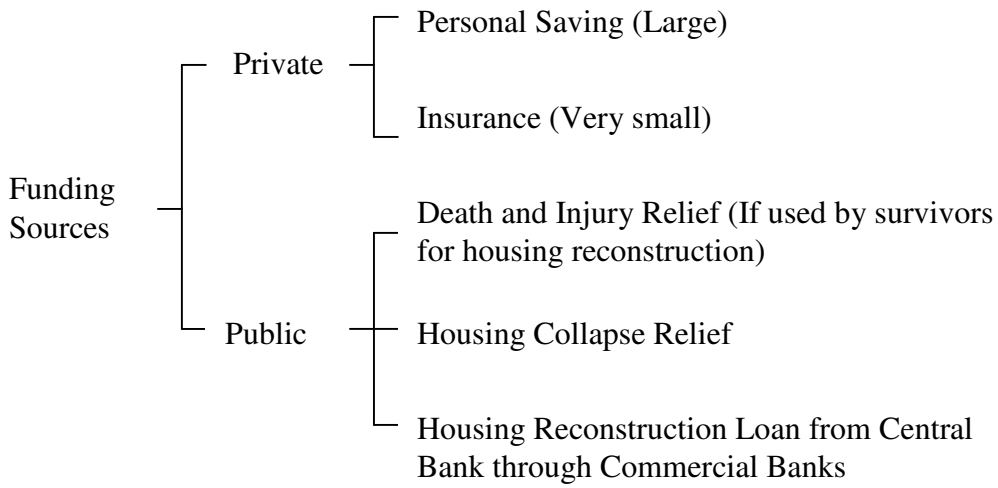


Figure 5-4 Funding Sources for Housing Reconstruction after Chi-Chi Earthquake

The factors that influenced housing reconstruction in Taiwan are very similar to those in the US except for the following two situations that appear to be unique in Taiwan:

1. A shift of the geodetic survey reference points. The quake caused a shift of the survey reference points, including the primary reference point in Puli Township[13]. Therefore, collapsed buildings could not be rebuilt before new cadastral maps were developed. It took about 18 months to finish making all of these new cadastral maps.
2. The complicated ownership of the land. The ownership of land in Taichung County, especially in the mountain area, is very complicated. Some lands are

[13] Puli Township is very near the epicenter of the Chi-Chi earthquake and is only about 50 miles from Taichung County

Aboriginal Reserved Land or Forest Experimental Land, but have been occupied by people for a long time. Some lands were inherited during the Japanese colonial era and their ownership was not clearly recorded. Until ownership was established, it was not possible for the residents to be approved to rebuild damaged or destroyed structures.

5.5 Housing Reconstruction Policies After The Earthquake

The central government announced 61 special ordinances and programs to speed housing reconstruction after the Chi-Chi earthquake. These ordinances can be classified into three types: streamlined procedures for housing reconstruction; housing reconstruction financial programs; and incentive mechanisms to encourage housing reconstruction (see Table 5-2). The policies of streamlining procedures for housing reconstruction included expediting building codes, and urban planning and renewal procedures. Besides the Housing Collapse Relief and Housing Reconstruction Loans that the Central Bank provided through commercial banks, the central government also established some policies for housing reconstruction finance such as relief for tearing down the totally collapsed buildings and relief from housing design fees. Incentive mechanisms that encouraged housing reconstruction included procedures to make new cadastral maps in the impact area and the establishment of a real estate ownership conflict mediation committee. These 61 housing reconstruction related policies were announced from ten days to more than one year after the earthquake. However, most of

these policies could have been prepared before the earthquake and adopted at that time or immediately after the earthquake.

Table 5-2 Major Policies for Housing Reconstruction after Chi-Chi Earthquake

Major Policies for Housing Reconstruction	Time of Adoption
Streamline procedure for housing reconstruction	
Expedite building permits	10 days after the earthquake
Streamline procedure for urban planning	55 days after the earthquake
Streamline procedure for urban renewal	66 days after the earthquake
Housing reconstruction financial programs	
Relief for tearing down totally collapsed buildings	140 days after the earthquake
Relief for housing design fee	183 days after the earthquake
Relief for farmer's housing reconstruction	118 days after the earthquake
Incentive mechanism to encourage housing reconstruction	
Procedure to make new cadastral maps in the impact area	139 days after the earthquake
Establishment of real estate ownership conflict mediation committee	216 days after the earthquake

Sources: Collections of Programs and Ordinances for 921 Earthquake Housing Reconstruction, 921 Earthquake Post-disaster Recovery Commission, 2002

5.6 Housing Reconstruction Speed

Data from Department of Building Regulation, Taichung County (see Table 5-3 and Figure 5-5) showed that the peak period of housing reconstruction was between March and July 2000, about 7 to 11 months after the earthquake. The peak month was in May 2000. The line on Figure 5-5 fluctuates during the peak period due to the meeting schedule of the building permits review panel. For example, some building permit applications submitted in late April were reviewed and issued in May 2000, depending on the meeting schedule of the review panel.

Table 5-3 Rebuilding Permits Issued in Taichung County

Issued Data	Cases	%	Issued Data	Cases	%
Nov-99	271	2.86	May-01	288	3.04
Dec-99	211	2.23	Jun-01	195	2.06
Jan-00	403	4.25	Jul-01	215	2.27
Feb-00	234	2.47	Aug-01	239	2.52
Mar-00	585	6.17	Sep-01	158	1.67
Apr-00	424	4.47	Oct-01	178	1.88
May-00	643	6.78	Nov-01	162	1.71
Jun-00	457	4.82	Dec-01	202	2.13
Jul-00	567	5.98	Jan-02	215	2.27
Aug-00	404	4.26	Feb-02	157	1.66
Sep-00	347	3.66	Mar-02	201	2.12
Oct-00	396	4.18	Apr-02	186	1.96
Nov-00	256	2.70	May-02	213	2.25
Dec-00	249	2.63	Jun-02	219	2.31
Jan-01	266	2.81	Jul-02	191	2.02
Feb-01	275	2.90	Aug-02	9	0.09
Mar-01	260	2.74	Sep-02	2	0.02
Apr-01	199	2.10	-	-	-

Note: 1. Data for Oct-99 was missing

2. Considering the mixing use of the land use pattern in Taiwan such as commercial use in the ground floor and residential use in the upper floor, the rebuilding permit data here including the residential buildings and commercial buildings.

Source: Department of Building Regulation, Taichung County

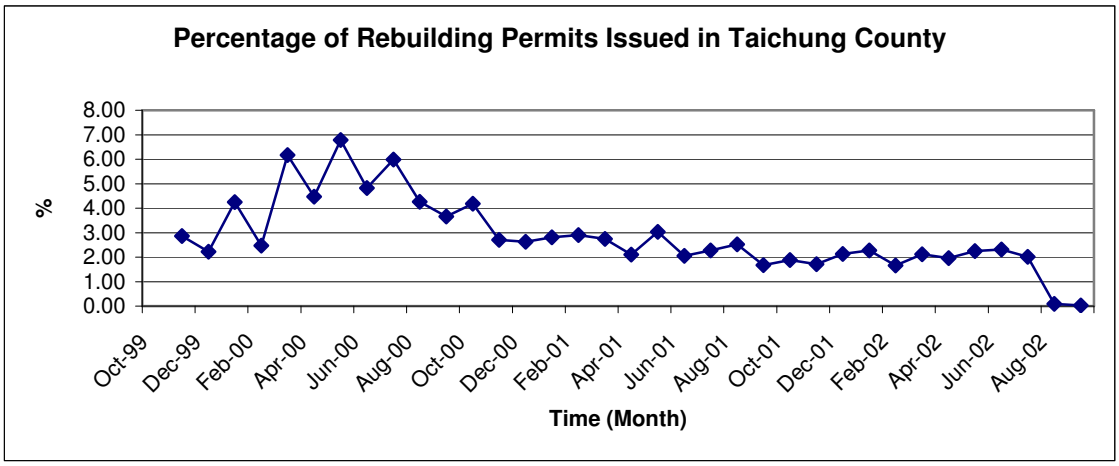


Figure 5-5 Percentage of Rebuilding Permits (All Structures) Issued in Taichung County

The reconstruction speed for totally collapsed condominium housing was far slower than other types of buildings. Table 5-4 shows that condominium reconstruction didn't start until almost one year later than other types of buildings. As of September 2002, only about 41% of the total 44 condominiums had been rebuilt or were under construction. Difficulty in reaching consensus on reconstruction among condominium owners was the most important factor affecting the speed of rebuilding. Moreover, the longer it took for the owners to reach consensus, the more difficult it was for them to reach agreement. The old ordinance required two thirds of the collapsed-condominium owners to agree to rebuild, but it was very difficult to reach this threshold. The central government amended this ordinance to lower the threshold from two-thirds to one-half almost four months after the earthquake. The 921 Fund Foundation was a semi-official organization that accepted worldwide donations right after the Chi-Chi earthquake. This

foundation played an important role in condominium housing reconstruction because it aimed to solve the problems that the government couldn't handle in the recovery phase due to the budget ordinance. In September 2000, the 921 Fund Foundation started a "Nest Building" program to pay the administration fee for the Home Owner's Association for necessary paperwork and procedures. This Foundation also promoted a "Jump Start" program in January 2002 to purchase some condominium units to cross the agreement threshold of one-half of the owners. The "Jump Start" program has been very useful for condominium reconstruction. Table 5-4 shows that the number of condominium rebuilding permits issued increased drastically after the inception of this program.

Table 5-4 Condominium Rebuilding Permits Issued in Taichung County

Issued Data	Cases	Issued Data	Cases
Dec-99	0	May-01	1
Jan-00	0	Jun-01	0
Feb-00	0	Jul-01	1
Mar-00	0	Aug-01	0
Apr-00	0	Sep-01	0
May-00	0	Oct-01	0
Jun-00	0	Nov-01	0
Jul-00	0	Dec-01	0
Aug-00	2	Jan-02	0
Sep-00	1	Feb-02	0
Oct-00	0	Mar-02	1
Nov-00	0	Apr-02	0
Dec-00	0	May-02	2
Jan-01	0	Jun-02	3
Feb-01	0	Jul-02	1
Mar-01	0	Aug-02	2
Apr-01	0	Sep-02	4

Source: 921 Earthquake Post-disaster Recovery Commission

5.7 Mitigation Issues in Housing Reconstruction

After the Chi-Chi earthquake, the central government promulgated the *Working Guidelines for Post-Earthquake Reconstruction Planning* on November 9, 1999 (one-and-a-half months after the earthquake). These guidelines were made by the Council for Economic Planning and Development to guide the development of local recovery plans. These guidelines mentioned four tasks that needed to be accomplished before making recovery plan. These four tasks were the promotion of earthquake-resistant building code standards, geology and damage assessment, land survey, and development of a damage information database. These guidelines also specified that a recovery plan should include an infrastructure recovery plan, an industry recovery plan and a life recovery plan. These three plans should overlap with the community recovery plan. The local governments, especially the eight township governments in Taichung County, finished their recovery plans between March and July of 2000--6 to 10 months after the earthquake.

As mentioned before, local governments relied heavily on support from the central government. Many local government officials considered the township recovery plan to be a blueprint to request money from the central government. This phenomenon was reflected in the content of the township recovery plans, which were very similar to their comprehensive development plans. Each township had a vision, such as becoming a college town or high technology cit, and expected the central government to invest in its plan, but none of these plans mentioned mitigation issues. This situation cannot be

blamed entirely on the township government officials; at least two other reasons contributed to this situation:

1. The planners making recovery plans are almost exactly the same group of people who made the comprehensive development plans, but unfortunately, none of them had any previous experience in making recovery plans.
2. The central government's *Working Guidelines for Post-Earthquake Reconstruction Planning* mentioned some mitigation issues in the four tasks that needed to done before making the recovery plan and the central government agreed to do these tasks. This misled local governments into that believing central governments would take care of all the mitigation, so, the local governments didn't consider mitigation to be a part of their responsibility during the recovery phase.

Instead, the interview data indicated that financial issues and reconstruction speed were the major issues for local government. Government officials were under a great deal of pressure from victims who wanted to rebuild their housing as soon as possible and were especially vulnerable to these demands because a presidential election was scheduled for six months after the earthquake.

Two mitigation policies were adopted by the central government after the earthquake as mentioned in the four tasks on the *Working Guidelines for Post-Earthquake Reconstruction Planning*. The first one was to increase the earthquake-resistant building code standards in the impact area. Taiwan is classified into two earthquake-risk zones and the Chi-Chi earthquake impact areas, including Taichung

County, were originally in the low risk area which had a less stringent earthquake-resistant building code. After the earthquake, the central government upgraded the impact area to a high risk zone and enforced the higher standard building code 40 days after the earthquake. Another mitigation-related policy was to prohibit building along the earthquake fault line. Fifty days after the earthquake, the central government announced a building moratorium within 50 meters along both sides of the Chi-Chi earthquake fault line for 53 days (to the end of year 1999). A new policy establishing a permanent building prohibition was announced on Dec 31,1999, but it narrowed the distance from 50 meters to 15 meters. The narrowing of this mitigation policy was due to the pressure from the victims living in this area and because mitigation issue was no longer a focusing event.

CHAPTER VI
FINDINGS AND CONCLUSIONS

6.1 Pre-impact Recovery Preparedness Plan in Two Study Areas

In Chapter I, this study concluded that a good pre-impact recovery preparedness plan for housing reconstruction should include the following criteria:

1. Establish agreement about long-term recovery goals,
2. Establish a task force and leading agency after a disaster,
3. Let the stakeholders know their roles,
4. Identify the recovery financing program for which different classes of residents are eligible,
5. Inform people where to find resources after the disaster, and
6. Make use of the window of opportunity, especially to integrate mitigation policies into recovery.

Using the criteria above to evaluate the situation right before and after the two earthquakes shows that (see Table 6-1):

1. The R& R plan in City of Los Angeles incorporated almost all the six criteria except for emphasizing the importance of the window opportunity. The City of Los Angeles had developed this plan in response to previous disaster experience such as 1987 Whittier Narrows earthquake and 1992 riots.

2. After the Northridge earthquake, even though the new city mayor and new planning director were unaware of the R& R plan, the City of Los Angeles still performed well during the recovery. Thanks to the previous planning processes, most of the city departments knew their roles and where to find resources.
3. The Los Angeles case shows that with a good pre-impact recovery plan, the recovery organization could function well even if the leadership is not strong.
4. Lacking any pre-impact recovery preparedness planning, the Taichung County government failed to meet the criteria, except that some local government officials had personal links with private sources to help with post-disaster recovery.
5. The central government led almost all the recovery policies after the Chi-Chi earthquake but the local officials still needed time to learn their new responsibilities and adapt national standards to local conditions.
6. The Taichung case shows that, without a pre-impact recovery plan, the recovery will processed slowly even if the upper level of government becomes involved and provides resources.

Table 6-1 Using Good Pre-impact Recovery Plan Criteria to Examine the Situation Immediately Before and After the Two Earthquakes

Criteria	LA		Taichung	
	Before Earthquake	After Earthquake	Before Earthquake	After Earthquake
Establish agreement about long-term recovery goals	●	●	×	×
Establish task force and leading agency after a disaster	●	■	×	■
Let the stakeholders know their roles	●	●	×	×
Identify the recovery financing program for which different classes of residents are eligible	●	●	×	O
Inform people where to find resources after the disaster	●	●	O	O
Make use of the window of opportunity to integrate mitigation policies into recovery	■	■	×	O

Note: ●: Very Great Extent; ■: Moderate Extent; O: Minimal Extent; ×: Not At All

6.2 Pre-impact Recovery Preparedness Plan and Housing Reconstruction Speed

The patterns of housing reconstruction in the City of Los Angeles and Taichiung County provide a positive answer for the first hypothesis of this study: Having a pre-impact preparedness recovery planning appears to increase the speed of housing reconstruction. From Figure 6-1, we can see that housing reconstruction in Los Angeles peaked about five months earlier than in Taichung County. Table 6-2 shows that the central government in Taiwan and the city government in Los Angeles adopted similar policies for housing reconstruction, but the adoption time in Taiwan was one week to two months later than that in Los Angeles. Moreover, local government officials in Taiwan took an even longer time to become familiar with the new policies and their implementation procedures. These findings support the first hypothesis that having a pre-impact preparedness recovery planning in fact does increase the speed of housing reconstruction.

Moreover, not having a pre-impact preparedness recovery planning makes reconstruction policies difficult to implement. The housing collapse relief situation in Taiwan provides a good example. Without pre-impact preparedness, it was very difficult to mobilize enough structural engineers to investigate damaged structures immediately after the earthquake. Therefore, the central government in Taiwan assigned elected neighborhood commissioners to investigate the damaged structures and classify them as “completely collapsed” or “partially collapsed”, and used that evaluation as the basis for determining the amount of housing collapse relief. The neighborhood commissioners not only lack professional knowledge to evaluate the collapsed

buildings, but they also used very low standards to classify the type of building collapse to gain favor in the next election.

Table 6-2 Similar Policies for Housing Reconstruction after the Earthquakes in City of Los Angeles and Taiwan

Post-disaster policies integrated into the pre-impact preparedness plan in City of Los Angeles	Equivalent post-disaster policies announced after the earthquake in Taiwan	Delay in policy adopted in Taiwan (Days after the earthquake)
Expedite rebuilding permits	Expedite rebuilding permits	10 days
Review and revise qualifying criteria for the city's neighborhood revitalization tools	Streamline procedure for urban renewal	66 days
Housing recovery financial programs from SBA, FEMA, HUD etc.	Housing collapse relief and housing reconstruction loans etc	8 to 10 days

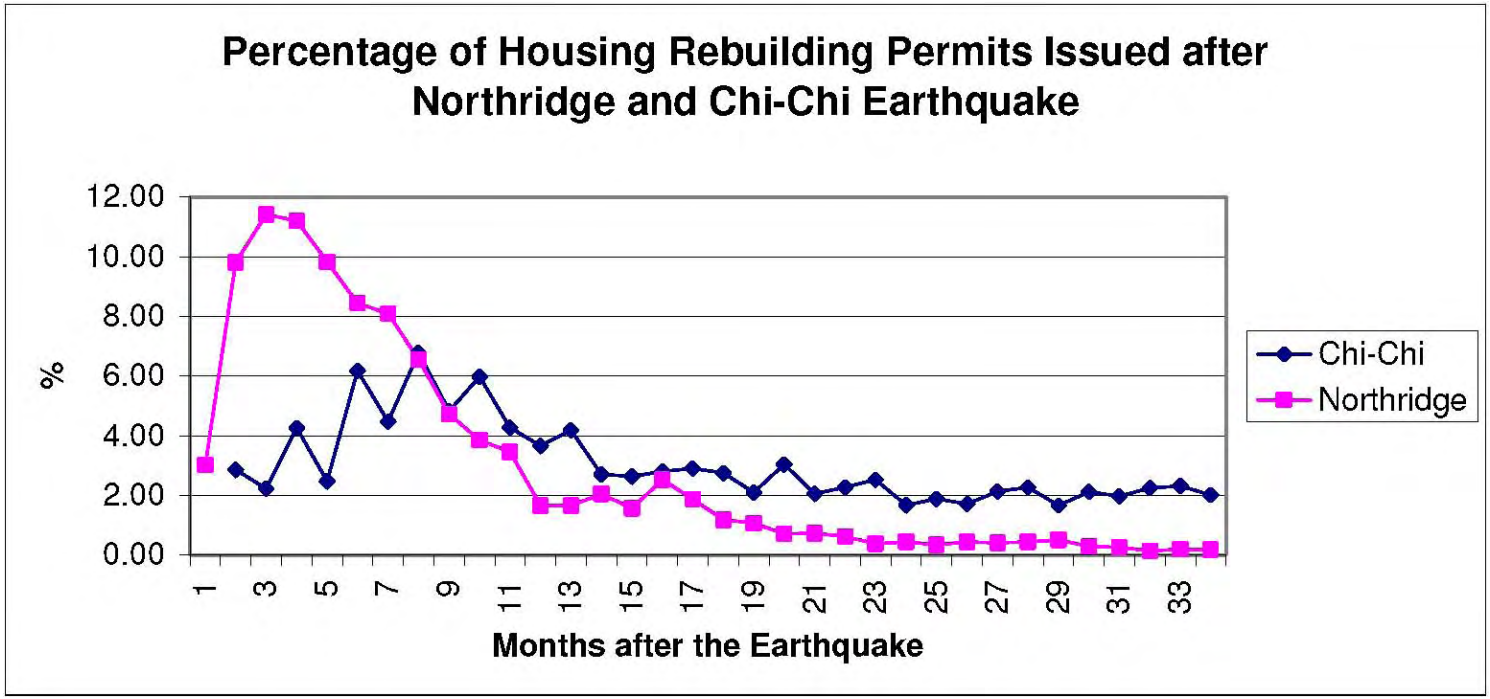


Figure 6-1 Percentage of Rebuilding Permits Issued after Northridge and Chi-Chi Earthquake

6.3 Pre-impact Recovery Preparedness Plan and Mitigation Issues

In its pre-impact recovery preparedness plan, the LA Department of Building and Safety had prepared a "retrofit of tilt-ups requirement" ordinance draft which was passed by the city council right after the Northridge Earthquake. Even though hazard mitigation is one element of the R&R plan, mitigation policies were still critical for the recovery phase. Most of the federal resources for hazard mitigation were used for public buildings or single-family buildings, but those hardest hit were the lower income residents living in multifamily buildings.

Taiwan's central government's guideline for a post-disaster recovery plans included a mitigation element for local governments after the Chi-Chi earthquake. Since the central government didn't actively promote hazard mitigation during the recovery phase, none of the local recovery plans in Taichung County mentioned mitigation. Indeed, the only mitigation policy successfully adopted by the central government was to enforce more stringent building code standards in the impact area. Another mitigation policy to establish a permanent building prohibition zone within 50 meters along the both sides of earthquake fault line was later weakened because of local resistance

The situations in Los Angeles and Taiwan cannot clearly prove that having a pre-impact recovery preparedness plan increases the extent to which hazard mitigation is integrated into the recovery process, but the case of retrofit tilt-ups in Los Angeles suggests that having a pre-impact recovery plan makes more effective use of the "window of opportunity."

6.4 Conclusion

Both the Northridge and Chi-Chi earthquakes were the most destructive earthquakes in their respective countries in the past half-century. Due to previous disaster experience, the City of Los Angeles had developed a unique pre-impact recovery preparedness plan before the Northridge earthquake, but no similar plan was made in Taiwan before the Chi-Chi earthquake.

Experiences following these two earthquakes show how pre-impact recovery preparedness plans function. Even though there are many differences between these two countries in their political and economic contexts, this study suggests that pre-impact recovery preparedness plans can speed the recovery process. This study also suggests that having a pre-impact recovery plan makes more effective use of the window of opportunity for hazard mitigation policy. However, the available data cannot clearly support the hypothesis that having a pre-impact recovery preparedness plan increases the extent to which hazard mitigation is integrated into the recovery process. The failed attempt to establish a prohibited building zone in Taiwan suggests that it is difficult to implement mitigation policies after a disaster because of the intense pressure from victims who want to rebuild their housing as soon as possible.

6.5 Research Limitation

Since this study is a comparative case study, the result of this study must be interpreted cautiously. Because of different political system as well as economic context in the two study areas, the result of the first hypothesis can only show the relationship between pre-impact recovery plan and housing reconstruction speed, but not the extent that pre-impact recovery plan increase or decrease the housing reconstruction speed.

6.6 Discussion and Recommendation

From the housing reconstruction experience following the two earthquakes, this study found that most of the recovery financial programs in both countries could be more easily obtained by the owners of the single family housings than those of multifamily housing. This is because the complicated ownership of condominiums and the poor financial situation of apartment owners made them ineligible to apply for recovery programs. In fact, the owners of condominiums were more in need of these recovery financial programs because most of them were of a lower income class compared to owners of signal family housing. The results of this study suggest that current recovery financial programs in Taiwan should consider the complicated reconstruction process of the condominiums and revise the programs to meet the need of these owners.

Even though the 921 Earthquake Post-Disaster Recovery Commission is still functioning, the future of this agency isn't clear yet. Source of these interviewed

believed that this “task-force” type agency will be eliminated after the reconstruction is completed. The results of this study suggest that the Taiwanese central government should have a specific permanent agency to integrate the entire disaster management policy, not just on response (such as Central Hazard Mitigation Council) or recovery (such as 921 Earthquake Post-Disaster Recovery Commission). Even if a permanent agency with an “all functions” mission were established, this can’t guarantee that local governments will have pre-impact recovery preparedness plans. Policy adoption is a complex process that begins with problem recognition and proceeds to policy formulation (Prater & Lindell, 2000). The formulation of pre-impact recovery plans by local governments is often facilitated by focusing event such as a disaster. Nonetheless, the concept of a pre-impact recovery plan should be promoted by emergency management experts and affected stakeholders before the occurrence of focusing event.

The results of this study also suggest that pre-impact recovery planning in local governments should place more emphasis on mutual aid agreements with other governments as well as with the private sector. From the experience of reconstruction following the Chi-Chi earthquake, local governments themselves did not have many resources and heavily relied on helps from central government and the private sector. Thus, having mutual aid agreement with other governments and the private sector should be an important element in pre-impact recovery planning in Taiwan.

HUD’s Office of Policy Development and Research (1995) found that federal mitigation resources were mismatched with the needs, because almost 80% of the damage units were multifamily housing, whereas most of the funds were for single-

family housings or public housings. This study suggests that the federal grants should have special hazard mitigation programs aimed at multifamily housings. Moreover, current hazard mitigation grants programs should begin to emphasize nonstructural mitigation methods.

6.7 Suggestions for Future Research

Because of the different political system and economic contexts in the Los Angeles and Taichung County, the study was not able to explain how much the pre-impact recovery plan in Los Angeles increases housing reconstruction speed as compared to Taichung County. Therefore, it would be a better research to compare two study areas that have more similar political and economical conditions.

The benefits of a pre-impact recovery plan are not only good for housing reconstruction. Thus, future studies on how pre-impact recovery plans influence the reconstructing of public buildings and infrastructure are also recommended.

This study shows the importance of making use of the window of opportunity to promote hazard mitigation policy. Therefore, studies based on the Kingdon's (1995) window closure theory that attempt to develop strategies to promote hazard mitigation will be an important topic. Moreover, the study to examine the duration of the opening window by different disaster is also recommended.

Since almost two-thirds of the housing reconstruction funding is from insurance companies, implementing hazard mitigation into earthquake insurance mechanism may

be a different way to promote hazard mitigation. Therefore, the study of methods to integrate hazard mitigation policies into insurance mechanism is recommend.

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Publications/ Presentations

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